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(71)Applicant : NIKON CORP

(72)Inventor : KATO KINYA
SEKI MASAMI

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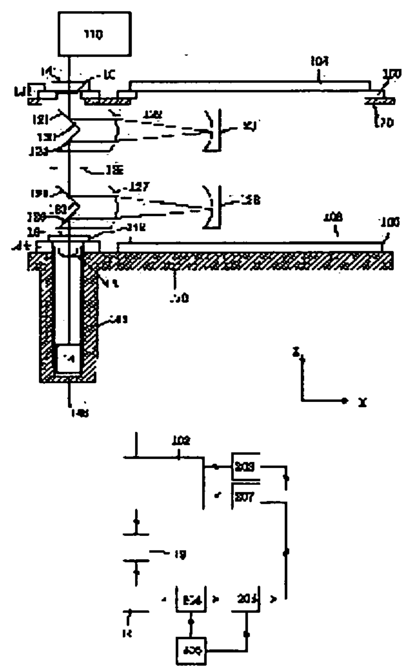
(54) PROJECTION EXPOSURE DEVICE



(57)Abstract:

PURPOSE: To improve the compatibility of a projection optical system consisting of plural projection optical units by arranging a lattice pattern of brightness in each of positions corresponding to the object face and the image face of the projection optical system and observing moire stripes for each projection optical unit which are generated at the time of throwing the illuminating light.

CONSTITUTION: An operation means 204 of this projection exposure device moves a carriage 170 and a detection unit 145 in the X direction and the Y direction respectively so that the detection unit 145 is placed in the visual field of a projection optical unit A. The operation means 204 detects the pitch or moire stripes formed on lattice patterns 16 and the direction or the angle of rotation between lattices by the detection unit 145 while driving an actuator 207 to rotate a prism. Next, the pitch of moire stripes and the angle of rotation are detected with respect to a projection optical unit B, and such adjustment is performed by a difference computing element 206 that pitches of moire stripes and angles of rotation of projection optical units A and B match each other.

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CLAIMS

[Claim(s)]
[Claim 1] In the projection aligner which carries out projection exposure of the pattern which was made to move the 1st substrate and 2nd substrate relatively to projection optics, and was formed on said 1st substrate on said 2nd substrate through said projection optics Said projection optics consists of two or more projection optics units which form the actual size erect image of the pattern formed in said 1st substrate on said 2nd substrate. Each of two or more of said projection optics units the 1st deviation member which deflects the light from said 1st substrate -- this -- with the reflecting mirror made to reflect the light from the 1st deviation member It is rucksack optical system. the 2nd deviation member which the light from this reflecting mirror is turned [2nd] to said 2nd substrate, and deflects it -- having -- and -- at least -- an image side -- a tele cent -- The projection aligner characterized by having the amendment means for amending the error of the mutual sense of two or more images formed on said 2nd substrate through said two or more projection optics units.
[Claim 2] The 1st light-and-darkness grid positioned in the location which said amendment means has a predetermined pitch, and is equivalent to the body side of said projection optics, this -- with the 2nd light-and-darkness grid positioned in the location which has the same pitch as the 1st light-and-darkness grid, and is equivalent to the image surface of said projection optics The observation means for observing the Moire fringe produced from the image of said 1st light-and-darkness grid by said projection optics unit, and said 2nd light-and-darkness grid, The projection aligner according to claim 1 characterized by having the positioning amendment means for amending each positioning of two or more of said projection optics units based on the Moire fringe observed with this observation means.
[Claim 3] The 1st partial optical system which forms the middle image of the pattern with which said projection optics unit was formed on said 1st substrate, the 2nd partial optical system which carries out re-image formation of said middle image on said 2nd substrate -- having -- this -- the projection aligner according to claim 1 or 2 characterized by equipping the 1st and 2nd partial optical system with said the 1st and 2nd deviation members and said reflecting mirrors, respectively.
[Claim 4] Said positioning amendment means is a projection aligner according to claim 2 or 3 characterized by amending the sense of the each and said 2nd deviation member of the 1st of two or more of said projection optics units.
[Claim 5] Said positioning amendment means is a projection aligner according to claim 2 or 3 characterized by amending the sense of each, and said 2nd [1st / the] deviation member and said reflecting mirror of two or more of said projection optics units.
[Claim 6] Said 1st light-and-darkness grid and said 2nd light-and-darkness grid are a projection aligner given in claim 2 which occupies the field of two projection optics units where arbitration adjoins at least, and is characterized by being movable in said pattern side and said image surface respectively thru/or any 1 term of 5.
[Claim 7] Said 1st light-and-darkness grid and said 2nd light-and-darkness grid are a projection aligner given in claim 2 characterized by occupying all the fields of said projection optics thru/or any 1 term of 5.
[Claim 8] Said light-receiving optical system is a projection aligner given in claim 2 to which it is characterized by equipping said observation means with the light-receiving optical system which forms the image of said Moire fringe by the illumination light through said said 1st light-and-

darkness grid and said two or more projection optics units, and said 2nd light-and-darkness grid, and the light-receiving means which carries out photo electric conversion of the image of said Moire fringe, and said projection optics unit side being a tele cent rucksack at least thru/or any 1 term of 7.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to self-amendment of the projection optics which consists of two or more projection optics units especially about a projection aligner.
[0002]
[Description of the Prior Art] In recent years, a liquid crystal display panel came to be used abundantly as display devices, such as a word processor, a personal computer, and television. On a glass substrate, pattern NINGU of the transparence thin film electrode is carried out, and a liquid crystal display panel is made by the configuration of a request by the technique of a photolithography in it. The aligner of the mirror projection type which exposes the subject-copy pattern formed on the mask to the photoresist layer on a glass substrate through projection optics as equipment for this lithography was used.
[0003] By the way, in the aligner conventional mirror projection type, in order to expand an exposure field, the exposure field was divided and exposed. The exposure field on the plate which is an exposed substrate is specifically divided into four fields, scan exposure of the 1st mask and 1st field is carried out, and the circuit pattern of the 1st mask is imprinted to the 1st field. Subsequently, while exchanging the 1st mask and 2nd mask, a plate is moved in step so that the exposure field and the 2nd field of projection optics may lap. And scan exposure of the 2nd mask and 2nd field is carried out, and the circuit pattern of the 2nd mask is imprinted on the 2nd field. The process same about the 3rd mask, 4th mask, 3rd field, and 4th field was repeated hereafter, and the circuit pattern of the 3rd mask and the 4th mask was imprinted to the 3rd field and 4th field, respectively.
[0004] Thus, when dividing and exposing an exposure field, in order to perform scan exposure of multiple times to one exposure field, a throughput (the amount of exposure substrates per unit time amount) is low. Furthermore, in division exposure, since a joint occurs between adjoining exposure fields, it is necessary to raise the splice precision. For this reason, while bringing the scale-factor error of projection optics close to 0, the large improvement in alignment precision will be required and the cost quantity of equipment will be caused.
[0005] On the other hand, in order to carry out scan exposure of the one big exposure field collectively, without carrying out division exposure, it is possible to attain enlargement of projection optics. However, in order to attain enlargement of projection optics, it is necessary to manufacture a large-sized optical element very with high precision, and, as a result, increase of manufacture cost and enlargement of equipment are caused. Moreover, it will cause by enlargement of projection optics, increase, i.e., the image formation performance degradation, of aberration.
[0006] Then, the projection aligner which constituted projection optics from two or more projection optics units which form an actual size erect image is proposed (Japanese Patent Application No. No. 161588 [five to]). In the projection aligner proposed by this application, each projection optics unit consists of a part I spectroscopy system and a part II spectroscopy system, and each partial optical system is the optical system of reflective molds, such as the Dyson mold and the Offner mold. Thus, in the projection aligner which constituted projection optics from two or more projection optics units, even when each projection optics unit is small, it has the advantage that scan exposure of the one big exposure field can be carried out as a whole.
[0007]

[Problem(s) to be Solved by the Invention] However, in an above-mentioned projection aligner, since each projection optics unit includes two or more reflectors, an error occurs in the mutual sense of the image which originates in the installation error of a reflector etc. and is formed through each projection optics unit, respectively. And since projection optics consisted of two or more projection optics units, unless the error of the mutual sense of the image mentioned above was amended, when scan exposure was carried out, there was un-arranging [that the adjustment between the images formed through each projection optics unit, respectively was spoiled].
[0008] This invention is made in view of the above-mentioned technical problem, and it aims at offering a projection aligner with the high adjustment between the images of each projection optics unit, constituting projection optics from two or more projection optics units.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the projection aligner by this invention has the following configurations. As shown in drawing 3 , for example, the projection aligner of this invention It is what carries out projection exposure of the pattern which was made to move the 1st substrate and 2nd substrate relatively to projection optics (21A-21C), and was formed on said 1st substrate on said 2nd substrate through said projection optics. Said projection optics consists of two or more projection optics units (21A, 21B, 21C) which form the actual size erect image of the pattern formed in said 1st substrate on said 2nd substrate. The 1st deviation member which each of two or more of said projection optics units makes deflect the light from said 1st substrate, It is rucksack optical system. this -- the reflecting mirror made to reflect the light from the 1st deviation member, and the 2nd deviation member which the light from this reflecting mirror is turned [2nd] to said 2nd substrate, and deflects it -- having -- and -- at least -- an image side -- a tele cent -- It is constituted so that it may have an amendment means for amending the error of the mutual sense of two or more images formed on said 2nd substrate through said two or more projection optics units.
[0010] According to the desirable mode of this invention, said amendment means The 1st light-and-darkness grid positioned in the location which has a predetermined pitch and is equivalent to the body side of said projection optics (15), this -- with the 2nd light-and-darkness grid (16) positioned in the location which has the same pitch as the 1st light-and-darkness grid, and is equivalent to the image surface of said projection optics The observation means for observing the Moire fringe produced from the image of said 1st light-and-darkness grid by said projection optics unit, and said 2nd light-and-darkness grid (13 14), It has the positioning amendment means for amending each positioning of two or more of said projection optics units based on the Moire fringe observed with this observation means.
[0011]
[Function] As mentioned above, in this invention, the grid pattern of light and darkness is arranged in the scanning projection aligner which has the projection optics which consists of two or more projection optics units, respectively in the location equivalent to the body side and the image surface of projection optics. The area pellucida and the opaque section are the patterns located in a line with regular-intervals parallel by turns, and each grid pattern is arranged mutual almost in parallel and mostly at the same direction. And the illumination light through two light-and-darkness grid patterns and projection optics is received, and a Moire fringe is observed about each projection optics unit.
[0012] If the sense of the image formed through each projection optics unit, respectively is the same so that it may mention later, the pitch of the Moire fringe observed about each projection optics unit is equal. If it puts in another way, the pitch of a Moire fringe can be measured about two projection optics units, and the error of the mutual sense of the image formed through each projection optics unit can be detected. therefore, the sense of the image formed through each projection optics unit can be made into about 1 law by making the sense of the reflector (the 1st and the 2nd deviation member, reflecting mirror) of each projection optics unit into about 1 law so that the pitch of a Moire fringe may become equal. Consequently, high projection exposure of the adjustment between each projection optics unit is attained.
[0013]
[Example] The example of this invention is explained based on an accompanying drawing. Drawing 1 is the perspective view showing the configuration of the projection aligner concerning the example

of this invention. Moreover, drawing 2 is drawing showing the configuration of the projection optics of the projection aligner of drawing 1 . In drawing 1 , the X-axis is set as the direction (scanning direction) where the plate 109 which consists of a mask 108 with which the predetermined circuit pattern was formed, and a glass substrate with which the resist was applied is conveyed, a Y-axis is set as the direction which intersects perpendicularly with the X-axis in the flat surface of a mask 108, and the Z-axis is set as the direction of a normal of a mask 108.

[0014] The projection aligner of illustration is equipped with the illumination-light study system 110 for illuminating the mask 108 within XY flat surface in drawing to homogeneity. The projection optics which consists of two or more projection optics unit 102a thru/or 102g is arranged in the lower part (- Z direction) of a mask 108. Each projection optics unit has the same configuration, respectively. It is laid on the stage 160 so that a plate 109 may become almost parallel to XY flat surface below at the pan of projection optics. In addition, a mask 108 and a plate 109 are moved in the drawing Nakaya mark direction (X0 direction) in one during scan exposure.

[0015] Drawing 2 is drawing showing the configuration of each projection optics unit roughly. The projection optics unit of illustration consists of the 1st partial optical system (121-124), a field diaphragm 125, and the 2nd partial optical system (126-129). The part I spectroscopy system (121-124) and the part II spectroscopy system (126-129) are the optical system of the Dyson mold, respectively, and have the same configuration.

[0016] The 1st reflector 121 of the prism 130 with which the 1st partial optical system deflects the light from a mask 108 to +X shaft orientations (drawing Nakamigi side), The plano-convex lens 122 for completing the light reflected in this 1st reflector 121, It consists of the 2nd reflector 124 of the prism 130 which deflects the light which carried out incidence of the light which passed this plano-convex lens 122 to the concave mirror 123 reflected in a plano-convex lens 122 through the plano-convex lens 122 to - Z direction in drawing. As mentioned above, it has the configuration with completely same the 1st partial optical system and the 2nd partial optical system. In drawing 2 , although a different sign from the component of the 1st partial optical system is given to the component of the 2nd partial optical system, the explanation which overlaps about the configuration of the 2nd partial optical system is omitted.

[0017] The illumination light which penetrated the mask 108 is deflected in the direction of +X (drawing Nakamigi side) in the 1st reflector 121 of prism 130, and carries out incidence to a plano-convex lens 122. It is reflected in the direction of -X (left-hand side in drawing) with a concave mirror 123, and incidence of the light which it converged with the plano-convex lens 122 is again carried out to a plano-convex lens 122. The light which passed the plano-convex lens 122 is deflected by - Z direction (method of drawing Nakashita) in the 2nd reflector 124 of prism 130, and the primary image of the pattern of a mask 108 is formed between the 1st partial optical system and the 2nd partial optical system. Thus, the primary image formed of the 1st partial optical system (121-124) is an actual size image of the mask 108 the lateral magnification of the direction of X is -1 time whose lateral magnification of the direction of Y of this in +1 time. In addition, the field diaphragm 125 is arranged in the location in which a primary image is formed.

[0018] The light from the primary image through a field diaphragm 125 is deflected in the direction of +X (drawing Nakamigi side) in the 1st reflector 126 of the prism 131 of the 2nd partial optical system, and carries out incidence to a plano-convex lens 127. It is reflected in the direction of -X (left-hand side in drawing) with a concave mirror 128, and incidence of the light which it converged with the plano-convex lens 127 is again carried out to a plano-convex lens 127. The light which passed the plano-convex lens 127 is deflected by - Z direction (method of drawing Nakashita) in the 2nd reflector 129 of prism 131, and the secondary image of the pattern of a mask 108 is formed on a plate 109.

[0019] As mentioned above, it has the configuration with completely same the 1st partial optical system and the 2nd partial optical system, and, as for the 2nd partial optical system, the lateral magnification of the direction of X forms the actual size image of the primary image it is -1 time whose lateral magnification of the direction of Y of this by +1 time. Therefore, the secondary image formed on a plate 109 through the 1st and 2nd partial optical system turns into an actual size erect image (image they are +1 time both whose lateral magnification of the direction of X, and the direction of Y of this) of a mask 108. Here, the projection optics unit which consists of the 1st and

2nd Dyson mold partial optical system is both-sides (both sides by the side of body and image) telecentric optical system.

[0020] Generally, in the Dyson mold optical system, the maximum visual field field where aberration is specified as a sufficiently small field becomes hemicycle-like mostly. Therefore, opening formed in a field diaphragm 125 is specified in the hemicycle-like maximum visual field field. Opening of trapezoidal shape is formed in the field diaphragm 125 in this example. In drawing 1 , visual field field 108a of trapezoidal shape thru/or 108g are prescribed to projection optics unit 102a thru/or 102g on a mask 108 by the field diaphragm arranged, respectively. Such visual field field 108a thru/or a 108g image are formed as an actual size erect image in exposure field 109a on a plate 109 thru/or 109g through projection optics.

[0021] Here, projection optics unit 102a thru/or 102d are arranged so that corresponding visual field field 108a thru/or 108d may be located in a line in the shape of a straight line along the direction of Y in drawing, i.e., the scan rectangular cross direction. On the other hand, projection optics unit 102e thru/or 102g are arranged so that it may stand in a line in the shape of [from which corresponding visual field field 8e thru/or 8g differ in visual field field 8a thru/or 8d along the direction of Y] a straight line.

[0022] In addition, both projection optics unit 102a and thru/or a 102d longitudinal direction [and], projection optics unit 102e and thru/or a 102g longitudinal direction are parallel to the X-axis, and it is constituted so that projection optics unit 102a a 102d reflector and projection optics unit 102e thru/or a 102g reflector may approach, namely, so that projection optics unit 102a of the 1st group projection optics unit 102e of 102d and the 2nd group thru/or 102g may counter. Furthermore, the 1st group and the 2nd group are arranged by turns along the direction of Y in projection optics units [102a 102e, 102b, 102f, 102c, 102g, and 102d] order.

[0023] In addition, visual field field 108a on a mask 108 thru/or 108g are prescribed by the opening configuration of the field diaphragm in the projection optics unit which corresponds, respectively. Therefore, it is not necessary to prepare visual field field 108a thru/or the optical system for specifying 108g strictly in the illumination-light study system 110. Thus, on a plate 109, exposure field 109a thru/or 109d are formed in the shape of a straight line along the direction of Y through projection optics unit 108a thru/or 108d, and exposure field 109e thru/or 109g are formed in the shape of a straight line along the direction of Y through projection optics unit 108e thru/or 108g. These exposure field 109a thru/or 109g are visual field field 108a on a mask 108 thru/or a 108g actual size erect image.

[0024] Subsequently, the physical relationship on visual field field 108a specified by projection optics unit 102a thru/or 102g thru/or the 108g mask 108 is explained. It is arranged so that the amount of [visual field field 108e of trapezoidal shape thru/or] 108g short side part may counter as well as a part for visual field field 108a of trapezoidal shape thru/or a 108d short side part, and the triangle-like edge where the visual field field which adjoins the triangle-like edge of each visual field field and this further corresponds overlaps in the direction of X (scanning direction).

[0025] Thus, visual field field 108a of the 1st group visual field field 108e of 108d and the 2nd group thru/or 108g are arranged by turns in the direction of Y because the field which projection optics unit 102a thru/or 102g occupy in XY flat surface becomes larger than visual field field 108a which corresponds, respectively thru/or 108g, since each projection optics unit is both-sides telecentric optical system.

[0026] Namely, in visual field field 108a specified by projection optics unit 102a thru/or the 102d field diaphragm arranged in the shape of a straight line thru/or 108d, spacing occurs in the direction of Y between each field. It will become impossible consequently, to secure the exposure field which continued in the direction of Y on the plate 109 only by projection optics unit 102a thru/or 102d. Then, projection optics unit 102e thru/or 102g were attached, visual field field 108a thru/or the direction spacing of Y of 108d were complemented with corresponding visual field field 108e thru/or 108g, and the exposure field which continued in the direction of Y is secured. In addition, in this example, the visual field fields [which are most located in an edge in the direction of Y in visual field field 108a thru/or 108g / 108a and 108d] edge is in agreement with the edge of the direction of Y of the field in which the pattern of a mask 108 is formed.

[0027] Thus, in visual field field 108a on a mask 108 thru/or 108g, the total of the die length of a

visual field field along a scanning direction (the direction of X) is fixed in the location of the arbitration of the scan rectangular cross direction (the direction of Y). That is, also in exposure field 109a which is the actual size erect image of a visual field field thru/or 109g, the total of the die length of a visual field field along a scanning direction (the direction of X) becomes fixed in the location of the arbitration of the scan rectangular cross direction (the direction of Y). Consequently, by scan exposure, it can continue the whole surface on a plate 109, and uniform exposure quantity of light distribution can be acquired.

[0028] Drawing 3 is drawing showing the configuration of the amendment means of the projection aligner concerning the example of this invention. Projection optics unit 21A thru/or 21C are the optical system of the Dyson mold which has the configuration shown in drawing 2 among drawing. The amendment means of illustration is equipped with the grid pattern 15 of the light and darkness arranged in the location equivalent to the projection pattern side of projection optics.

[0029] Moreover, the grid pattern 16 of the light and darkness of the same configuration as the grid pattern 15 is formed in the location equivalent to the image surface of projection optics. In addition, the grid patterns 15 and 16 are patterns (pattern with which the area pellucida and the opaque section were located in a line with regular-intervals parallel by turns) of the same pitch, and are positioned mutual almost in parallel and mostly by the same direction. In drawing 3 , some grid patterns 15 and 16 are shown for clear-izing of a drawing.

[0030] The amendment means of illustration equips further the pan of the light-receiving lens 13 arranged at the method of drawing Nakashita of projection optics, and this light-receiving lens 13 with the image sensors 14 arranged at the method of drawing Nakashita. In addition, as for the photo sensor 13, the body side (projection optics unit 21A - 21C side) consists of tele cent rucksacks at least. Moreover, as a drawing destructive line shows, a photo sensor 13 and image sensors 14 are united, and are constituted movable in the direction along the image surface of each projection optics unit, and sequential migration can be carried out at the method of drawing Nakashita of each projection optics unit. Furthermore, the grid pattern 16 and the light-receiving side of image sensors 14 have conjugation relation. In this way, the illumination light 1 from an illumination-light study system (un-illustrating) passes the grid pattern 15, each projection optics unit, and the grid pattern 16, and is received with image sensors 14 through the light-receiving lens 13.

[0031] Next, with reference to drawing 4 and drawing 5 , the configuration of the grid patterns 15 and 16 of this example, the light-receiving lens 13, and image sensors 14 is explained. Drawing 4 is the perspective view showing the configuration of the stage in this example roughly, and has adopted drawing 3 and corresponding system of coordinates. Moreover, drawing 5 is XZ sectional view of this example. In drawing 4 , the mask 108 is laid by the technique of vacuum adsorption on the movable mask stage 150 along the inside of XY flat surface. This mask stage 150 has opening for passing the exposure light which passes a mask 108 as it is shown in drawing 5 . In addition, the pattern side (field in which a pattern is prepared) of the mask 108 laid on a mask stage 150 serves as the bottom (plate 109 side).

[0032] It returns to drawing 4 and the plate 109 is laid by the technique of vacuum adsorption on the movable plate stage 160 along the inside of XY flat surface. Here, the mask stage 150 and the plate stage 160 are established in the carriage 170 which has a "C character-like" cross section in YZ flat surface, respectively. This carriage 170 is formed movable along the direction of X.

[0033] The glass susceptor 143 which supports substrate glass 141 with the grid pattern 15 is fixed to a part (edge contiguous to the mask stage 150 on carriage 170) which is different in the mask stage 150 on carriage 170. As shown in drawing 5 , it has opening for passing the light from the illumination-light study system 110 in which this glass susceptor 143 also passes the grid pattern 15. In addition, the grid pattern 15 of the substrate glass 141 laid on the glass susceptor 143 serves as the bottom (plate 109 side), and it is located in the same field as the pattern side of the mask 108 on a mask stage 150.

[0034] It returns to drawing 4 and the glass susceptor 144 which supports substrate glass 142 with the grid pattern 16 is fixed to a part which is different in the plate stage 150 on carriage 170. As shown in drawing 5 , this glass susceptor 144 has opening for passing the light which passes the grid pattern 16. In addition, the grid pattern 16 of the substrate glass 142 laid on the glass susceptor 144 is located in the same field as the field of a plate 109 top (mask 108 side).

[0035] Moreover, it returns to drawing 4 and the grid pattern 15 on glass substrate top 141 and the grid pattern 16 on a glass substrate 142 have the pitch which met in the direction of X in drawing. And the guide 146 which is the slot which extended in the direction of Y in drawing is formed in carriage 170. Here, the detection unit 145 which has the light-receiving lens 13 and image sensors 14 which are shown in drawing 3 is attached in the slot of a guide 146 movable. Therefore, the detection unit 145 becomes movable along the direction of Y in drawing. In addition, although not illustrated, the linear encoder is prepared in the detection unit 145, and it has the composition that the location of the direction of Y of the detection unit 145 is detectable.
[0036] As shown in drawing 5 , the grid pattern 16 on a glass substrate 142 and the image pick-up side of image sensors 14 are conjugate with the light-receiving lens 13 of the detection unit 145. And of the projection optics (122-128) by which the grid pattern 16 on a glass substrate 142 and the grid pattern 15 on a glass substrate 141 are arranged among these grid patterns 15 and 16, since it is relation [****], in image sensors 14, the image (3rd image) of the grid pattern 15 and the image (correctly primary image) of the grid pattern 16 are formed. That is, on image sensors 14, the Moire fringe of the grid pattern 15 and the grid pattern 16 is formed.
[0037] In addition, in this example, although the grid pattern 15 is formed on carriage 170, it may be prepared in the part on the mask stage 150 which supports a mask 108. Moreover, although the grid pattern 16 is formed on carriage 170, it may be prepared in the part on the stage 160 which supports a plate 109.
[0038] Here, when the light-receiving lens 13 is not a body side tele cent rucksack (a projection optics 122-128 side is a tele cent rucksack), since the scale factor on image sensors 14 changes with the distance fluctuation between the light-receiving lens 13 and the grid pattern 16 and detection of an exact pitch becomes difficult, it is not desirable. In this example, since the light-receiving lens 13 is a body side tele cent rucksack, when the light-receiving lens 13 and image sensors 14 are united and move, even if distance fluctuation with a grid pattern arises, a pitch can be detected correctly.
[0039] Drawing 6 is drawing explaining the relation between a location gap of the reflector of a projection optics unit, and the sense of the image formed, and (a) shows the case where, as for (b), the 2nd whole partial optical system carries out the location gap of the case where only the reflector of the 2nd partial optical system carries out a location gap. In addition, the projection optics unit shown in drawing 6 is the optical system of the Dyson mold which has the configuration shown in drawing 2 .
[0040] If the prism which has the 1st and 2nd reflectors of the 2nd partial optical system rotates only an include angle theta towards illustration centering on an optical axis 2 in drawing 6 (a) Although the sense of the primary image 32 of the projection pattern 31 formed in the location of a field diaphragm 7 is not influenced at all, the secondary image 33 of the projection pattern 31 formed in the image surface location of a projection optics unit will rotate only include-angle 2theta towards illustration centering on an optical axis 2.
[0041] On the other hand, in drawing 6 (b), if the 2nd whole partial optical system rotates only an include angle theta towards illustration centering on an optical axis 2 Although the sense of the primary image 32 of the projection pattern 31 formed in the location of a field diaphragm 7 is not influenced at all, the secondary image 33 of the projection pattern 31 formed in the image surface location of a projection optics unit will rotate only include-angle 2theta towards illustration centering on an optical axis 2. If it puts in another way, the sense of the image formed can be adjusted by rotating the reflector of a projection optics unit to the circumference of an optical axis 2. Thus, if a rotational error is in installation of the reflector of each projection optics, since the sense of the image formed through each projection optics unit, respectively will not become fixed, when scan exposure is carried out, the adjustment between the images formed through each projection optics unit, respectively is spoiled. Moreover, even if the whole projection optics unit is attached in the condition that there is a rotational error to other whole projection optics unit, the adjustment between the images formed, respectively is spoiled.
[0042] On the other hand, since the grid pattern 15 and the grid pattern 16 are in the location which is equivalent to the projection pattern side and the image surface of projection optics, respectively, two grid patterns have a conjugation relation mutually. And the grid pattern 15 and the grid pattern 16 are arranged almost in parallel and mostly at the same direction. Therefore, a Moire fringe can be

observed in image sensors 14. The pitch p of the Moire fringe observed sets the pitch of a light-and-darkness grid to d, sets the angle of rotation between grids (it corresponds to the crossed axes angle of the secondary image of the grid pattern 15, and the grid pattern 16) to delta, and is expressed with a degree type (1).

p = D/delta (1)

[0043] Since the pitch d of a light-and-darkness grid is a constant, if its pitch p of the Moire fringe observed is fixed, it is detectable that the crossed axes angle delta of the secondary image of the grid pattern 15 and the grid pattern 16 is fixed. Here, two kinds of sense of the secondary image of the grid pattern 15 to the grid pattern 16 is considered only by the absolute value of the crossed axes angle delta of two grid patterns being equivalent to the pitch p of a Moire fringe. therefore, if the sense of a reflector is also doubled and adjusted, rotating the reflector of each projection optics unit suitably to the circumference of an optical axis while measuring the pitch of a Moire fringe about each projection optics unit so that the pitch of a Moire fringe may become about 1 law between each projection optics unit, the error of the mutual sense of the image formed through each projection optics unit can be amended.

[0044] To rotate only the reflector of the prism of the 2nd partial optical system of a projection optics unit and specifically amend according to drawing 6 (a), it is necessary to separate prism and a plano-convex lens. On the other hand, to rotate the reflector and amend with the 2nd whole partial optical system of a projection optics unit according to drawing 6 (b), it is necessary to rotate the whole optical system shown by the reference mark 20 in drawing 3 towards the drawing Nakaya mark.

[0045] Next, with reference to drawing 7 , the adjustment device of the projection optics unit in this example is explained. Drawing 7 (a) is XY top view of a projection optics unit, drawing 7 (b) is XZ top view of a projection optics unit, and drawing 7 (c) is YZ top view of a projection optics unit. In addition, the projection optics unit shown in drawing 7 shows only the 2nd partial optical system (126-129).

[0046] In drawing 7 (a) and (b), the prism 131 with a reflector 126,129 is held at housing 209a, and the lens-barrel 210 which supports a plano-convex lens 127 and a concave mirror 128 to one is held at housing 209b. Here, Housings 209a and 209b are united through hinge region part 209c prepared in three places along XZ flat surface including the optical axis Ax of the plano-convex lens 127 and concave mirror 128 which are shown with the alternate long and short dash line in drawing. Prism 131 and a lens-barrel 210 are constituted rockable in YZ flat surface by making hinge region part 209c into the center of rotation. In addition, hinge region part 209c used as the center of rotation becomes the location which does not shade the flux of light which passes projection optics at this time.

[0047] Drawing 7 (b) is briefly explained with reference to drawing 7 (c) which is the top view seen from the direction side of-X in drawing. In drawing 7 (c), housing 209a is set in YZ flat surface, and it is two openings 209a1 and 209a2. It has. Prism 131 is these openings 209a1 and 209a2. It is attached so that it may cover. Hinge region part 209c used as the center of rotation is enclosed with the slash in drawing, and drawing 7 (c) has shown. This hinge region part 209c is opening 209a1 and 209a2 as illustration. It turns out that it is prepared along with the Z direction so that it may insert, and the above-mentioned connection part is located out of range [the visual field specified by the field diaphragm 125 of drawing 2].

[0048] It returns to drawing 7 (a) and the actuator 207 which consists of a piezoelectric device or a laminating mold piezoelectric device, and the displacement sensor 208 which consists of a capacitive type sensor are formed in the elastic hinge 209 which consists of housings 209a and 209b and hinge region part 209c.

[0049] If an actuator 207 is made to expand and contract as shown in drawing 8 , the reflector of prism 131 will rotate to a lens-barrel 210 by making hinge region part 209c into the center of rotation, and the image by the projection optics unit will rotate the rotation theta twice the rotation of this prism 131. If the amount of displacement of the housings 209a and 209b in the location of a displacement sensor 208 is set to delta and distance of the direction of Y of hinge region part 209c and a displacement sensor 208 is set to L here, it is the rotation theta of prism 131. Theta**delta/L (2)

It is come out and expressed. When distance L of the direction of Y of the hinge region part 209c and the displacement sensor 208 a displacement sensor 208 is the precision which is about 10nm, and is [displacement sensor] the center of rotation here is set to 100mm 10nm / 100mm=0.1microrad (0.02") (3) ,
The rotation theta of prism can be measured by ******. Therefore, as an actuator 207, if a piezo-electric element with a resolution of 1nm is used, for example, the rotation of prism is controllable by the precision of above-mentioned 0.1microrad.
[0050] In addition, although the roll control of the prism 131 is carried out in the example shown in drawing 7 and drawing 8 to the lens-barrel 210 holding a plano-convex lens 127 and a concave mirror 128 instead, if prism 131, a plano-convex lens 127, and a concave mirror 128 are held in one by the lens-barrel and an actuator 207, a displacement sensor 208, and the elastic hinge 209 are formed in the connection part of this lens-barrel and the body of an aligner, the roll control of the 2nd whole partial optical system will become possible.
[0051] Moreover, what is necessary is just to prepare this hinge region part 209c in the edge of the elastic hinge 209 in the direction of -Y, when spacing of prism 131 and a plano-convex lens 127 is not fully securable although three hinge region part 209c is prepared in YZ flat surface including an optical axis in the example shown in drawing 7 and drawing 8 . At this time, hinge region part 209c becomes one member of the configuration prolonged in the Z direction, and it is prepared in XZ flat surface which does not include an optical axis.
[0052] Next, the control system of an actuator 207 and a displacement sensor 209 is explained with reference to drawing 9 . In drawing 9 , the light-receiving lens 13 has magnifying power, and forms the expansion image of the Moire fringe formed on the grid pattern 16 on the image pick-up side of image sensors 14. The operation means 204 measures the pitch of a Moire fringe based on the output from image sensors 14. Moreover, the operation means 204 makes memory 205 memorize the pitch of this Moire fringe. difference -- a computing element 206 takes the difference of the pitch of a Moire fringe, and the pitch of the Moire fringe memorized by memory, and it drives an actuator 207 so that this difference may serve as a constant rate.
[0053] The example of the above-mentioned control is explained in full detail with reference to drawing 3 thru/or drawing 5 , drawing 9 , and drawing 10 . In addition, drawing 10 is the flow chart Fig. showing an example of the control action by this example.
[0054] [Step 0] At step 0, the operation means 204 moves carriage 170 in the direction of X, and moves the detection unit 145 in the direction of Y so that the detection unit 145 may be located in the visual field of projection optics unit 21A. Then, the operation means 204 shifts to the following step 1.
[0055] [Step 1] At step 1, the operation means 204 detects the pitch p of a Moire fringe and the direction of the angle of rotation delta between grids which are formed on the grid pattern 16 of the detection unit 145, rotating prism by making an actuator 207 drive. Then, the operation means 204 shifts to the following step 2.
[0056] [Step 2] At step 2, memory 205 is made to memorize the detection result by step 1, and it shifts to the following step 3.
[0057] [Step 3] At step 3, it judges whether adjustment has ended the operation means 204 about all projection optics units. In this explanation, since the adjustment about the projection optics units 21B and 21C is not completed, it shifts to step 4.
[0058] [Step 4] At step 4, the operation means 204 performs step 0 and step 1 about projection optics unit 21B, and shifts to step 5.
[0059] [step 5] -- step 5 -- difference -- it judges whether it is equal to the thing of projection optics unit 21A the pitch p about projection optics unit 21B and the direction of an angle of rotation delta were remembered to be in memory 205 by the computing element 206. It is here, and in not being equal, the operation means 204 shifts to the following step 6, and when equal, it shifts to step 11.
[0060] [step 6] -- step 6 -- the operation means 204 -- difference -- an actuator 207 is driven so that the output of a computing element 206 may become fixed. At this time, it acts as the monitor of the angle of rotation and hand of cut of prism by the displacement sensor 208. Then, an operation means shifts to step 7.
[0061] [Step 7] At step 7, it judges whether adjustment has ended the operation means 204 about all

projection optics units. In this explanation, since the adjustment about projection optics unit 21C is not completed, it shifts to step 8.
[0062] [Step 8] At step 8, the operation means 204 performs step 0 and step 1 about projection optics unit 21C, and shifts to step 9.
[0063] [step 9] -- step 9 -- difference -- it judges whether it is equal to the thing of projection optics unit 21A the pitch p about projection optics unit 21B and the direction of an angle of rotation delta were remembered to be in memory 205 by the computing element 206. It is here, and in not being equal, the operation means 204 shifts to the following step 10, and when equal, it shifts to step 11.
[0064] [step 10] -- step 10 -- the operation means 204 -- difference -- an actuator 207 is driven so that the output of a computing element 206 may become fixed. At this time, it acts as the monitor of the angle of rotation and hand of cut of prism by the displacement sensor 208. Then, an operation means shifts to step 11.
[0065] [Step 11] At step 11, it judges whether adjustment completed the operation means 204 about all the projection optics units 21A-21C. In addition, in this step 11, since adjustment is completed about all the projection optics units 21A-21C, explanation is ended.
[0066] In addition, in above-mentioned explanation, although explained taking the case of 3 sets of projection optics units 21A-21C, as shown in drawing 3 , when 3 or more sets of projection optics units exist, adjustment actuation is the same. Furthermore, in above-mentioned explanation, although based on projection optics unit 21A, the projection optics unit made into criteria may be any projection optics unit. Moreover, in above-mentioned explanation, it is constituted so that it may become movable [the detection unit 145 / the direction (the scan rectangular cross direction) of Y], but this detection unit 145 may be formed so that it may become movable in XY flat surface, as shown in drawing 3 .
[0067] Projection optics is constituted from an actual projection aligner by many projection optics units. Therefore, although it is desirable to constitute so that the field of the whole projection optics may be occupied with the grid patterns 15 and 16 of a pair, carrying out sequential migration of the grid pattern which occupies the field of two projection optics units where arbitration adjoins at least into a projection pattern side and the image surface, respectively, the whole projection optics may be covered and amendment actuation may be performed. Moreover, since there is an error of a grid pitch in an actual grid pattern, in case the pitch of a Moire fringe is measured, it is desirable to refer to the average pitch in an observation full field.
[0068] Thus, in this example, since the error of the sense of the image between each projection optics unit resulting from the assembly error of each projection optics unit etc. is measured and fine control of the error of the sense of the image between each projection optics unit is carried out based on the result, each pattern image through each projection optics unit can be imprinted on a plate with high adjustment. Moreover, the always stabilized scan exposure is attained by performing the above-mentioned fine control periodically. In addition, although this example explained this invention taking the case of the projection optics unit which consists of two partial optical system of the Dyson mold, the projection optics unit may consist of two partial optical system of the Offner mold, and may consist of one or two partial optical system of other reflective molds.
[0069] In addition, in an above-mentioned example, although the light-receiving lens 13 and image sensors 14 as an observation means were made movable, two or more photo sensors and image sensors may be arranged under each projection optics unit (image side of each projection optics unit), respectively. In this case, it is desirable to prepare each light-receiving lens so that the optical axis of two or more light-receiving lenses may be in agreement with the optical axis of each projection optics unit, respectively.
[0070]
[Effect] As explained above, in this invention, high scan projection exposure of the adjustment between the images of each projection optics unit can be performed, constituting projection optics from two or more projection optics units.

[Translation done.]

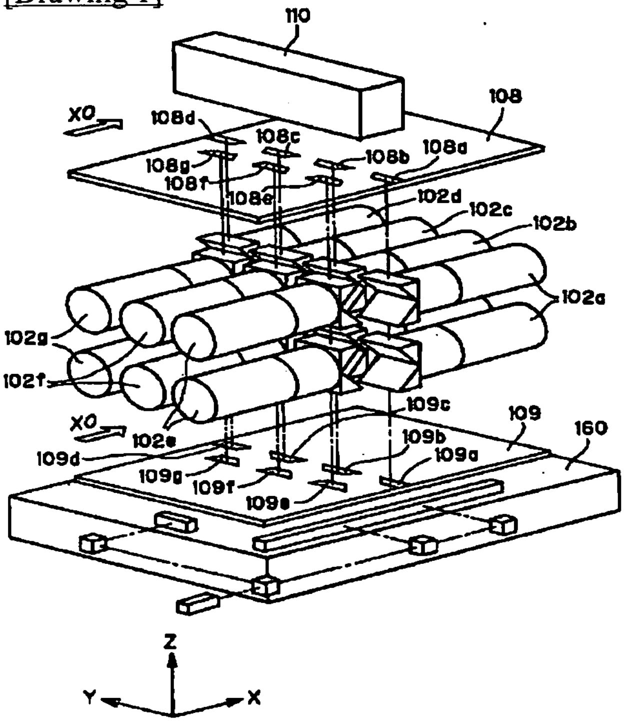
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing the configuration of the projection aligner concerning the example of this invention.
[Drawing 2] It is drawing showing the configuration of the projection optics of the projection aligner of drawing 1 .
[Drawing 3] It is drawing showing the configuration of the amendment means of the projection aligner concerning the example of this invention.
[Drawing 4] It is drawing showing the configuration of the stage concerning the example of this invention.
[Drawing 5] It is the sectional view of the projection aligner concerning the example of this invention.
[Drawing 6] It is drawing explaining the relation between a location gap of the reflector of a projection optics unit, and the sense of the image formed, and (a) shows the case where, as for (b), the 2nd whole partial optical system carries out the location gap of the case where only the reflector of the 2nd partial optical system carries out a location gap.
[Drawing 7] It is drawing showing the configuration of a projection optics unit, and (a) is [XZ sectional view and (c of XY sectional view and (b))] YZ top views.
[Drawing 8] It is drawing showing adjustment actuation of a projection optics unit typically.
[Drawing 9] It is the block diagram of the projection aligner concerning the example of this invention.
[Drawing 10] It is the flow chart Fig. showing an example of the actuation in the projection aligner concerning the example of this invention.
[Description of Notations]
15 16 Light-and-darkness grid
13 Image Formation Lens
14 Image Sensors
102 Projection Optics Unit
108 Mask
109 Plate
110 Illumination-Light Study System
125 Field Diaphragm

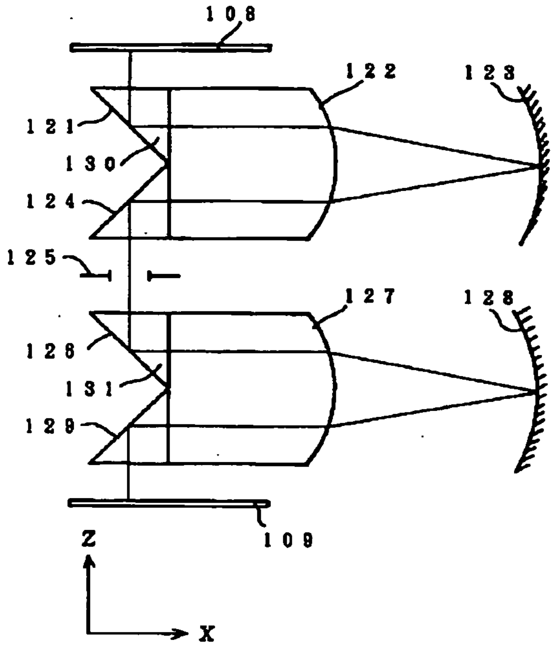
[Translation done.]

DRAWINGS

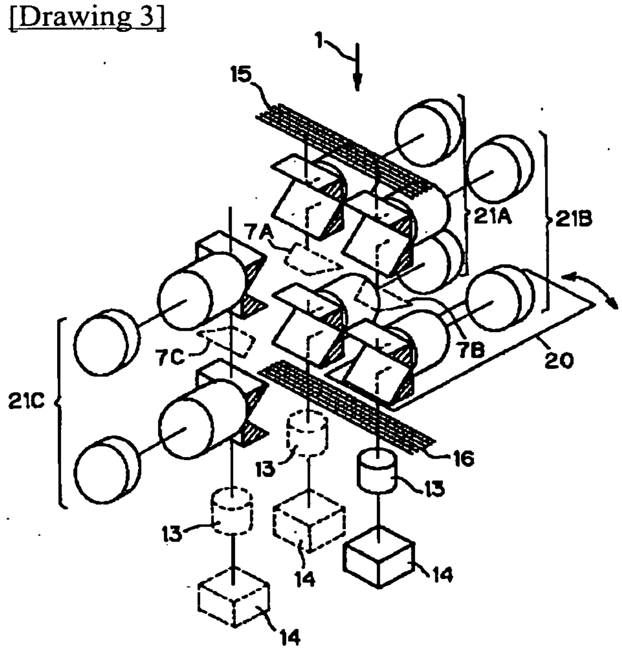
[Drawing 1]



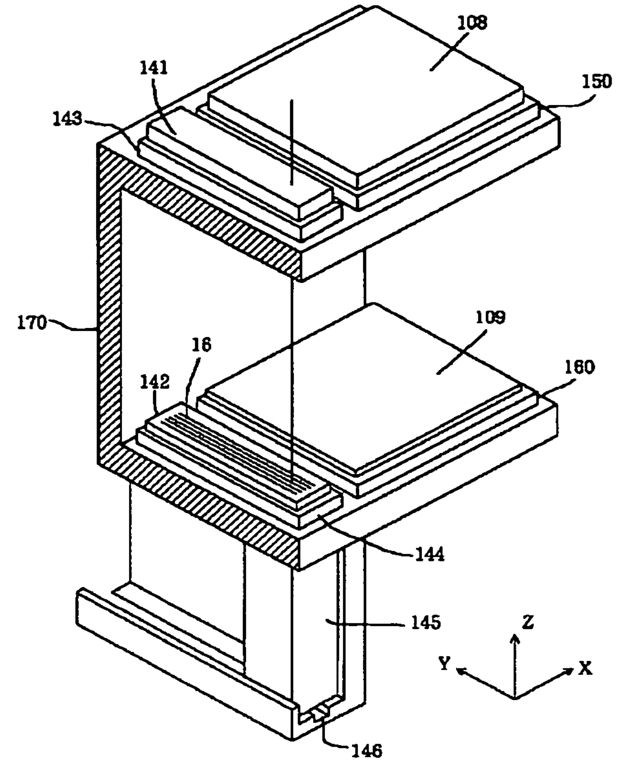
[Drawing 2]



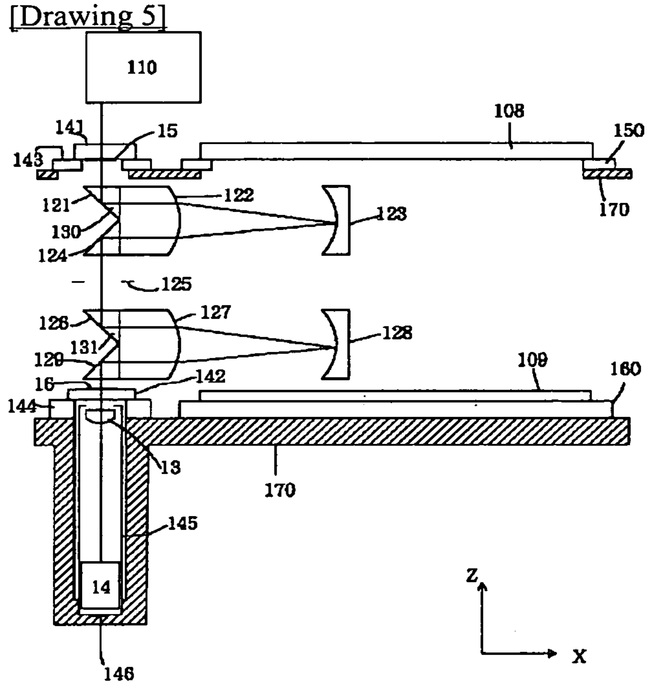
[Drawing 3]



[Drawing 4]

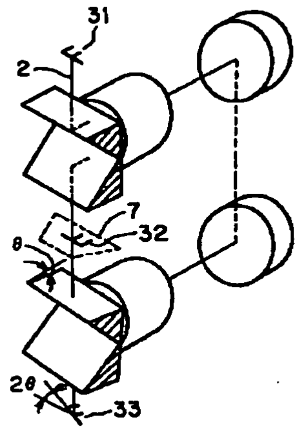


[Drawing 5]

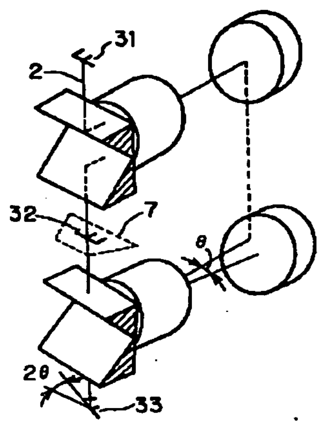


[Drawing 6]

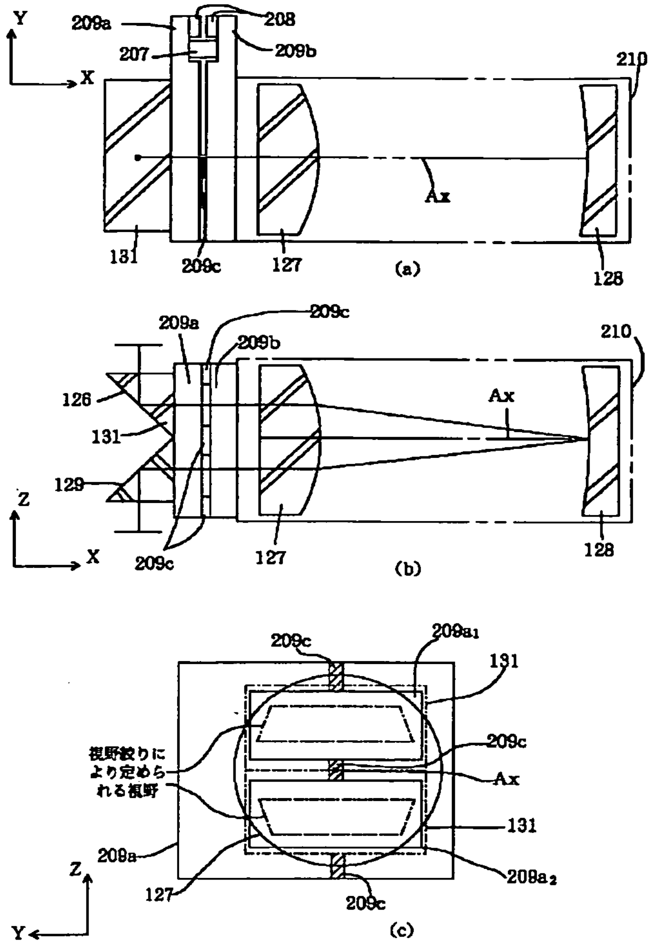
(a)



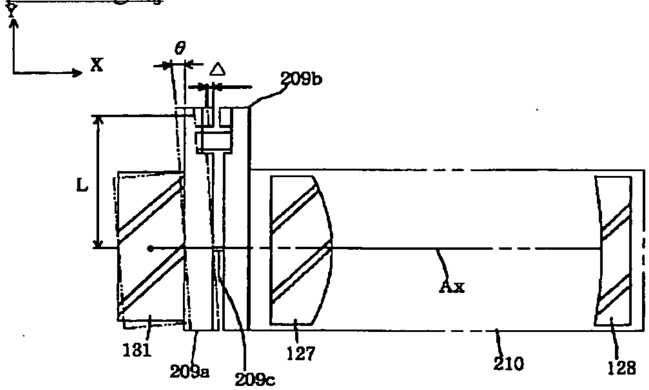
(b)



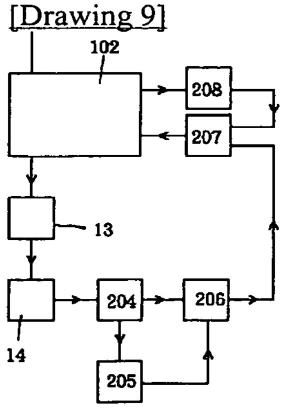
[Drawing 7]



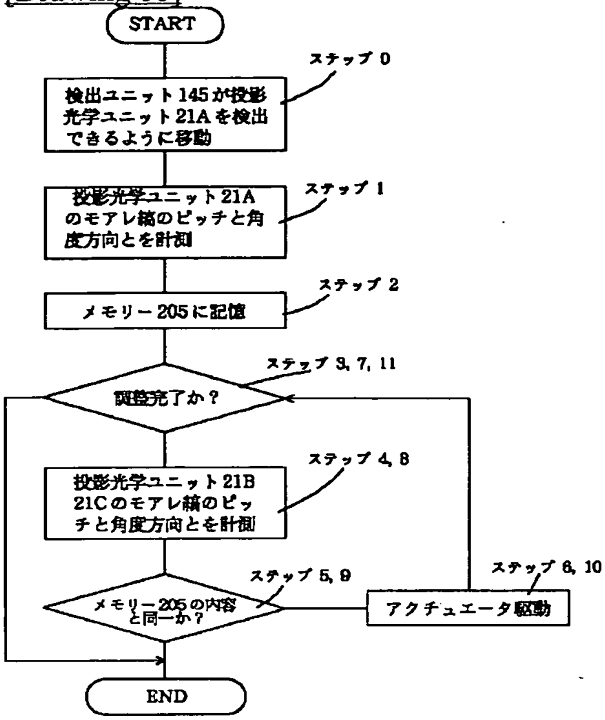
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

CORRECTION OR AMENDMENT

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G02B  27/18
G03F   7/20    521
H01L  21/027
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[FI]

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G02B  27/18          A
G03F   7/20    521
H01L  21/30    518
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[Procedure revision]
[Filing Date] December 3, Heisei 13 (2001. 12.3)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] In the projection aligner which carries out projection exposure of the pattern which was made to move the 1st substrate and 2nd substrate relatively to projection optics, and was formed on said 1st substrate on said 2nd substrate through said projection optics,
Said projection optics consists of two or more projection optics units which form the actual size erect image of the pattern formed in said 1st substrate on said 2nd substrate,
the 1st deviation member which each of two or more of said projection optics units makes deflect the light from said 1st substrate -- this -- the reflecting mirror made to reflect the light from the 1st deviation member, and the 2nd deviation member which the light from this reflecting mirror is turned [2nd] to said 2nd substrate, and deflects it -- having -- and -- at least -- an image side -- a tele cent -- rucksack optical system -- it is
The projection aligner characterized by having the amendment means for amending the error of the mutual sense of two or more images formed on said 2nd substrate through said two or more projection optics units.
[Claim 2] The projection aligner according to claim 1 characterized by providing the following Said amendment means is 1st light-and-darkness grid positioned in the location which has a

predetermined pitch and is equivalent to the body side of said projection optics. this -- the 2nd light-and-darkness grid positioned in the location which has the same pitch as the 1st light-and-darkness grid, and is equivalent to the image surface of said projection optics The observation means for observing the Moire fringe produced from the image of said 1st light-and-darkness grid by said projection optics unit, and said 2nd light-and-darkness grid The positioning amendment means for amending each positioning of two or more of said projection optics units based on the Moire fringe observed with this observation means

[Claim 3] the following -- having -- this -- the projection aligner according to claim 1 or 2 characterized by equipping the 1st and 2nd partial optical system with said the 1st and 2nd deviation members and said reflecting mirrors, respectively. Said projection optics unit is 1st partial optical system which forms the middle image of the pattern formed on said 1st substrate. 2nd partial optical system which carries out re-image formation of said middle image on said 2nd substrate

[Claim 4] Said positioning amendment means is a projection aligner according to claim 2 or 3 characterized by amending the sense of the each and said 2nd deviation member of the 1st of two or more of said projection optics units.

[Claim 5] Said positioning amendment means is a projection aligner according to claim 2 or 3 characterized by amending the sense of each, and said 2nd [1st / the] deviation member and said reflecting mirror of two or more of said projection optics units.

[Claim 6] Said 1st light-and-darkness grid and said 2nd light-and-darkness grid are a projection aligner given in claim 2 which occupies the field of two projection optics units where arbitration adjoins at least, and is characterized by being movable in said pattern side and said image surface respectively thru/or any 1 term of 5.

[Claim 7] Said 1st light-and-darkness grid and said 2nd light-and-darkness grid are a projection aligner given in claim 2 characterized by occupying all the fields of said projection optics thru/or any 1 term of 5.

[Claim 8] Said observation means is equipped with the light-receiving optical system which forms the image of said Moire fringe by the illumination light through said said 1st light-and-darkness grid and said two or more projection optics units, and said 2nd light-and-darkness grid, and the light-receiving means which carries out photo electric conversion of the image of said Moire fringe,
Said light-receiving optical system is a projection aligner given in claim 2 characterized by said projection optics unit side being a tele cent rucksack at least thru/or any 1 term of 7.

[Claim 9] The sense of said deviation member is a projection aligner given in claim 1 characterized by the ability to adjust thru/or any 1 term of 8.

[Claim 10] The sense of said deviation member and said reflecting mirror is a projection aligner given in claim 1 characterized by the ability to adjust thru/or any 1 term of 8.

[Claim 11] The projection exposure approach characterized by carrying out projection exposure of the subject-copy pattern formed on the mask as said 1st substrate on said 2nd substrate through projection optics using a projection aligner given in claim 1 thru/or any 1 term of 10.

[Claim 12] In the projection exposure approach which carries out projection exposure of the pattern which was made to move the 1st substrate and 2nd substrate relatively to projection optics, and was formed on said 1st substrate on said 2nd substrate through said projection optics,
The process which deflects the light from said 1st substrate according to the 1st reflector,
The process in which the light from said 1st reflector is reflected according to the 2nd reflector,
The process whose 2nd [said / the] is made to for [substrate HE] ****** light from said 2nd reflector according to the 3rd reflector,
the image side tele cent from said 3rd reflector -- the process which forms said pattern image on said 2nd substrate based on the rucksack flux of light,
The projection exposure approach characterized by having the process which carries out rotation adjustment of said pattern image centering on the direction which intersects perpendicularly with the field in which said pattern image is formed.

[Claim 13] The projection exposure approach according to claim 12 characterized by adjusting the part of said the 1st thru/or 3rd reflector, or all sense in order to carry out rotation adjustment centering on the direction which intersects perpendicularly with the field in which said pattern image is formed.

[Translation done.]